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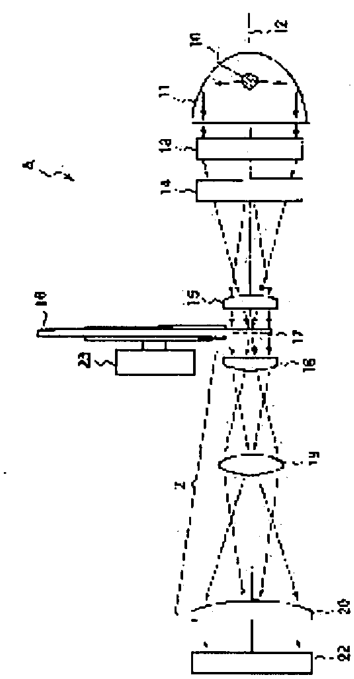
(54) PICTURE DISPLAY DEVICE AND PROJECTION PICTURE DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a picture display device capable of realizing color sequential display having high color purity and high efficiency by setting the temporal numerical aperture of a spatial light modulation element to be high regardless of the size or the state of a light emitting body without making the device larger, and to provide a projection type picture display device using this picture display device.
SOLUTION: This picture display device A is equipped with the light emitting body 10, a parabolic mirror 11, anamorphic lenses 13 and 14, an auxiliary lens 15, a rotary type color filter 16, a relay lens system 21 being a 2nd illumination system constituted of an input part converging lens 18, a center part converging lens 19 and an output part converging lens 20, and a liquid crystal panel 22.



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CLAIMS

[Claim(s)]

[Claim 1] The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, It is the image display device equipped with the 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element. Said 1st illumination system Said lighting spot which abbreviation's is in the aspect ratio of the viewing area of said space light modulation element by carrying out, and has an aspect ratio is formed. Said 2nd illumination system The red and blue which are formed with said rotation mold color filter, and each green colored light and the display of said space light modulation element are synchronized, and said lighting spot and said space light modulation element are considered as abbreviation conjugate relation. The direction of a shorter side of said lighting spot, The image display device characterized by what is done for the abbreviation coincidence of the circumferencial direction of said rotation mold color filter.

[Claim 2] The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, The 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element, Said lighting spot which has uniform brightness distribution is formed. preparation ************** -- it is -- said 1st illumination system -- an optical integrator component -- having -- abbreviation -- said 2nd illumination system The red and blue which are formed with said rotation mold color filter, and each green colored light and the display of said space light modulation element are synchronized, and said lighting spot and said space light modulation element are considered as abbreviation conjugate relation. The direction of a shorter side of said lighting spot, The image display device characterized by what is done for the abbreviation coincidence of the circumferencial direction of said rotation mold color filter.

[Claim 3] The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, It is the image display device equipped with the 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element. Said 1st illumination system While forming the real image of said light source near the exit pupil which forms said lighting spot, it has an aperture diaphragm near said exit pupil. Said 2nd illumination system The red and blue which are formed with said rotation mold color filter, and each green colored light and the display of said space light modulation element are synchronized, and said lighting spot and said space light modulation element are considered as abbreviation

conjugate relation. The direction of a shorter side of said lighting spot, The image display device characterized by what is done for the abbreviation coincidence of the circumferencial direction of said rotation mold color filter.
[Claim 4] In an image display device given in any 1 term of claim 1 thru/or claim 3 said 2nd illumination system The input section convergent lens arranged near [said] the lighting spot, and the output section convergent lens arranged near [said] the space light modulation element, Said input section convergent lens and the center-section convergent lens arranged at the optical path between said output section convergent lenses, A preparation and said input section convergent lens make the light which carries out incidence to said input section convergent lens converge near the opening core of said center-section convergent lens. It is the image display device characterized by what said output section convergent lens draws for the light which carries out outgoing radiation from said center-section convergent lens effective in a space light modulation element by said center-section convergent lens forming the real image of the body near the principal plane of said input section convergent lens near the principal plane of said output section convergent lens.
[Claim 5] In claim 2 thru/or an image display device according to claim 4 said 1st illumination system It has the 1st lens array which comes to arrange two or more 1st lenses in the shape of-dimensional [2], and the 2nd lens array which comes to arrange two or more 2nd lenses in the shape of-dimensional [2]. Said two or more 1st lenses While dividing into two or more partial flux of lights the flux of light which carries out outgoing radiation from said condensing means, said partial flux of light is made to converge near the opening of said 2nd lens corresponding to said 1st lens. Said two or more 2nd lenses While drawing said two or more partial flux of lights which carry out outgoing radiation from said 1st corresponding lens near the rotation mold color filter, make these superimpose and a lighting spot is formed. Said 1st lens array and said 2nd lens array are an image display device characterized by what said uniform lighting spot of abbreviation brightness is formed for as said optical integrator component.
[Claim 6] The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, The 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element, It is the image display device equipped with the projection lens which projects the optical image displayed on said space light modulation element. Said 1st illumination system Said lighting spot which abbreviation's is in the aspect ratio of the viewing area of said space light modulation element by carrying out, and has an aspect ratio is formed. Said 2nd illumination system The red and blue which are formed with said rotation mold color filter, and each green colored light and the display of said space light modulation element are synchronized, and said lighting spot and said space light modulation element are considered as abbreviation conjugate relation. The direction of a shorter side of said lighting spot, The projection mold image display device characterized by what is done for the abbreviation coincidence of the circumferencial direction of said rotation mold color filter.
[Claim 7] The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, The 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element, The projection lens which projects the optical image displayed on said space light modulation element, Said lighting spot which has uniform brightness distribution is formed. preparation ************** -- it is -- said 1st illumination system -- an optical integrator component -- having -- abbreviation -- said 2nd illumination system The red and blue which are formed with said rotation mold color filter, and each green colored light and the display of said space light modulation element are synchronized, and said lighting spot and said space light modulation element are considered as abbreviation conjugate relation. The direction of a shorter side of said lighting spot, The projection mold image display device characterized by what is done for the abbreviation coincidence of the circumferencial direction of said rotation mold color filter.

[Claim 8] The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, The 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element, It is the image display device equipped with the projection lens which projects the optical image displayed on said space light modulation element. Said 1st illumination system While forming the real image of said light source near the exit pupil which forms said lighting spot, it has an aperture diaphragm near said exit pupil. Said 2nd illumination system The red and blue which are formed with said rotation mold color filter, and each green colored light and the display of said space light modulation element are synchronized, and said lighting spot and said space light modulation element are considered as abbreviation conjugate relation. The direction of a shorter side of said lighting spot, The projection mold image display device characterized by what is done for the abbreviation coincidence of the circumferencial direction of said rotation mold color filter.

[Claim 9] In an image display device given in any 1 term of claim 6 thru/or claim 8 said 2nd illumination system The input section convergent lens arranged near [said] the lighting spot, and the output section convergent lens arranged near [said] the space light modulation element, Said input section convergent lens and the center-section convergent lens arranged at the optical path between said output section convergent lenses, A preparation and said input section convergent lens make the light which carries out incidence to said input section convergent lens converge near the opening core of said center-section convergent lens. It is the projection mold image display device characterized by what said output section convergent lens draws for the light which carries out outgoing radiation from said center-section convergent lens effective in a space light modulation element by said center-section convergent lens forming the real image of the body near the principal plane of said input section convergent lens near the principal plane of said output section convergent lens.

[Claim 10] In claim 7 thru/or an image display device according to claim 9 said 1st illumination system It has the 1st lens array which comes to arrange two or more 1st lenses in the shape of-dimensional [2], and the 2nd lens array which comes to arrange two or more 2nd lenses in the shape of-dimensional [2]. Said two or more 1st lenses While dividing into two or more partial flux of lights the flux of light which carries out outgoing radiation from said condensing means, said partial flux of light is made to converge near the opening of said 2nd lens corresponding to said 1st lens. Said two or more 2nd lenses While drawing said two or more partial flux of lights which carry out outgoing radiation from said 1st corresponding lens near the rotation mold color filter, make these superimpose and a lighting spot is formed. Said 1st lens array and said 2nd lens array are a projection mold image display device characterized by what said uniform lighting spot of abbreviation brightness is formed for as said optical integrator component.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention -- red and blue -- green -- the image display device which comes to combine the illumination-light study system which changes the illumination light in three primary colors which becomes more to a high speed, and supplies it, and the space light modulation element which is synchronized with this and indicates each color subject-copy image in three primary colors by sequential, and the light which carries out outgoing radiation from this image display device are led to a projection lens, and it is related with the projection mold image display device which carries out expansion projection of the display image of a space light modulation element.
[0002]
[Description of the Prior Art] The DMD component (digital micro mirror component) which is the liquid crystal panel and reflective mold display device which are a light-receiving mold display device is well used for the space light modulation element (SLM) used for the image display device and big screen projector (projection mold image display device) for an AV equipment, or the objects for presentations or workstations.
[0003] By the way, the liquid crystal panel used for an image display device etc. is constituted so that each color subject-copy image of R (red), G (green), and B (blue) may be serially changed to a high speed and may be displayed on it in itself, since the color picture according to the video signal supplied from the outside is constituted, although monochrome image is displayed. Therefore, a liquid crystal ingredient with a quick speed of response, for example, a ferroelectric liquid crystal, is used. Generally, although known as a monochrome binary display application, this ferroelectric liquid crystal is constituted so that it may become possible to form each color subject-copy image of R, G, and B in three primary colors since the gradation display using the so-called pulse width (time-axis) modulation can be performed, as a result a full color display can be realized by controlling On period of a white display. Moreover, the DMD component used for an image display device etc. arranges minute mirror structure in the shape of two-dimensional, and it carries out On/Off control of the direction in which the light which carries out incidence is reflected, and it is constituted so that light may be modulated spatially and an optical image may be formed.
[0004] As an approach of constituting a color picture in the image display device and projection mold image display device using these liquid crystal panels or a DMD component The method make each color subject-copy image in three primary colors which consists of red, blue, and green correspond, and using the display device of three sheets, The method form a mosaic-like color filter on the display device of one sheet, and using the trio pixel of RGB, Moreover, as mentioned above, each one color subject-copy image of R (red), G (green), and B (blue) is indicated by time series using the space light modulation element of monochrome display, and there is the approach of generally calling color sequential means of displaying which is the method which is synchronized with each color subject-copy image, and changes the color of the illumination light.
[0005] Hereafter, the image display device using the space light modulation element by this color sequential means of displaying is explained. Drawing 15 is the schematic diagram of the conventional image display device which adopted the space light modulation element by color sequential means of displaying. A lamp (here, not shown) forms an emitter 101 and an emitter 101 serves as the light source which emits the white light. A concave mirror 102 condenses the white light which an emitter 101 emits, and forms the lighting spot 104 on the rotation mold color filter 103. For this reason, the reflector of a concave mirror 102 is made into an ellipsoid configuration, an emitter 101 is arranged to the 1st focus, and the rotation mold color filter 103 is arranged in the condensing location equivalent to the 2nd focus. In addition, although especially illustration is not carried

out here, the flux of light which advances in parallel using a parabolic mirror is formed, add a condenser lens, the flux of light is made to converge on a focal plane, and the lighting spot 104 may be formed. And the color sequential illumination light which carries out outgoing radiation from the lighting spot 104 turns into parallel light with a condenser lens 108, and the liquid crystal panel 109 of a transparency mold is illuminated, consequently the display image of a color is shown to an observer.
[0006] thus -- the image display device using the light source which emits the white light -- the white light -- a high-speed RGB color order -- in order to change to degree illumination light, the above rotation mold color filters are used. This rotation mold color filter is what arranged suitably the color filter segment of red transparency, green transparency, and blue transparency on the periphery which drives by the motor and is rotated at a high speed, and as a result of the illumination light's passing these rotating color filters, the color sequential illumination light which changes to a high speed with R->G->B is formed.
[0007] This rotation mold color filter is explained further, referring to a drawing. Drawing 16 indicates the lighting spot 104 formed on it to be an example of the configuration of the rotation mold color filter 103. The rotation mold color filter 103 is what combined the color filter of R, G, and B in three primary colors in the shape of a right circle, and, specifically, red transparency filter 107R, green transparency filter 107G, and blue transparency filter 107B** have fixed it to the rotation base material (hub) 106 directly linked with the motor 105. And a high speed is made to rotate red transparency filter 107R combined with the hub 106, green transparency filter 107G, and blue transparency filter 107B according to the control signal from the outside. And the lighting spot 17 is formed on the periphery to which these color filters were joined, and color filters 29R, 29G, and 29B rotate at a high speed, make it synchronize with a display image according to each color subject-copy image which a liquid crystal panel 22 displays, and form the illumination light of a suitable color. Thus, each color filter removes the light of a specific wavelength band about the white light which passes the lighting spot 104, and forms the color sequential illumination light which changes to a high speed as a result. Moreover, although the die clo IKKU filter which formed multilayers on the glass substrate by the vacuum evaporationo method of construction or the spatter method of construction is used as this color filter in many cases, this die clo IKKU filter has the description that the wavelength band property (cut-off wavelength) of the light which multilayers are made to penetrate depending on the incident angle of the beam of light which carries out incidence changes.
[0008] By the way, in the rotation mold color filter 103, if nothing is processed when the lighting spot 104 passes the filter joint which the filter of a different color adjoins, the illumination light with which a fixed period and not desired primary lights but two colors were mixed will be formed, and the image of a right color is no longer shown. In order to prevent this, time amount while a color changes needs to consider a space light modulation element (liquid crystal panel) as a black display, and it needs to prepare an idle period so that a color subject-copy image may not be displayed in the meantime. The illumination light which carries out incidence to a color filter at this idle period is not used effectively, and does not contribute to the brightness of a presentation image. Moreover, generally in a space light modulation element, the period of a color required to change is quite longer than a data transfer period required for renewal of a color subject-copy image.
[0009] Thus, it is one of the standards which show the time amount numerical aperture of a space light modulation element, and the efficiency for light utilization of a call and a space light modulation element about the rate to the perimeter term period of the effective display period of an image the color in a space light modulation element changes, and excluding the period. Usually, this time amount numerical aperture is about 80 - 90%. It can consider as the image display device which can obtain a bright image, so that this time amount numerical aperture improves.
[0010] The case where the above-mentioned rotation mold color filter and a liquid crystal panel are combined about the time amount numerical aperture of this space light modulation element is explained further. Since it is used for the purpose which generally displays TV images, such as NTSC system, a liquid crystal panel 22 should just form the color picture of 60 frames in 1 second, if a liquid crystal panel 22 is used for TV images, such as NTSC system, for example. Therefore, a liquid crystal panel 22 is constituted so that 1 / 60 seconds may be trichotomized with the three primary colors of RGB, namely, each color subject-copy image in three primary colors may be displayed one by one like R->G->B->R every [1/] 180 seconds. Drawing 3 shows the procedure of the image displayed on a liquid crystal panel 22, and about the image of the n-th frame, a red subject-copy image is expressed as R (n), and it expresses G (n) and a blue subject-copy image as B (n) for the green subject-copy image here.
[0011] In the rotation mold color filter 16, since the color sequential illumination light produced when the joint of

an adjacent color filter passes the lighting spot 17 will be in the condition that two colors were mixed, it cannot be used for the display of an image. For this reason, in the case where it is shown in drawing 3 , effectual display period tauon given to one color subject-copy image is what lengthened the idle period prepared in order to avoid color mixture from that perimeter term period taua. Therefore, the time amount numerical aperture of a liquid crystal panel is expressed with tau on/tau a.
[0012] In order to make the image of an image display device brighter, it can consider making the power of the lamp used for the light source increase here, but since making power increase means the increment in power consumption, as a result the calorific value in an image display device increases, this approach is not desirable. It is more effective to raise a time amount numerical aperture rather.
[0013] By the way, the time amount numerical aperture of this space light modulation element Since it is dependent on the magnitude of the lighting spot 104 formed on the rotation mold color filter 103, and the rate of the circumferencial direction to which a filter joint passes the lighting spot 104 If the rotation mold color filter of a bigger radius is used when the magnitude of a lighting spot is the same, the rate at which a filter joint passes a lighting spot on a periphery relatively will become quick, and, as a result, the direction of the rotation mold color filter of a big radius can make high the time amount numerical aperture of a space light modulation element. Moreover, when the magnitude of a rotation mold color filter is the same, the one where the magnitude of a lighting spot is smaller can make high relatively the time amount numerical aperture of a space light modulation element.
[0014] Among these, if it is the approach of enlarging a rotation mold color filter, although the time amount numerical aperture of a space light modulation element can be made high, the miniaturization of the whole equipment becomes difficult because a rotation mold color filter becomes large-sized. Since new technical problems, such as a color filter becoming still more expensive, it being necessary to also enlarge driving torque of a required motor namely, and a motor being enlarged, and becoming expensive, are produced, this approach is not desirable.
[0015] Therefore, a desirable approach can be told to that making a lighting spot small makes high the time amount numerical aperture of a space light modulation element. And the magnitude of a lighting spot is decided by the illuminating angle of the magnitude of the emitter used for the light source of an image display device, and the condensing optical system which forms a lighting spot.
[0016] If the size of an emitter is examined first, it is so obvious that an emitter is made small that a lighting spot becomes small.
[0017] Next, if the illuminating angle of condensing optical system is examined and an illuminating angle will be enlarged, according to the so-called invariant of the Lagrange-helmholtz, the magnitude of the image formed, i.e., the magnitude of a lighting spot, can be made small. In this case, the angles of convergence of the light which carries out incidence to a color filter become large, and a color filter acts to the beam-of-light group in which the include-angle variability region spread more. However, when a die clo IKKU filter which is conventionally used for the rotation mold color filter of an image display device and which was mentioned above is made to act to a beam-of-light group with a large illuminating angle, desired cut-off wavelength is not obtained about a beam-of-light group with a large incident angle, but there is a problem of passing the low beam of light of the color purity which originally is not required, or preventing passage of the high beam of light of color purity required reverse originally. Namely, the primary lights of desired color purity cannot be obtained about the colored light after filtering. It will be necessary to make it shift the cut-off wavelength of a filter to a high color purity side to obtain desired color purity. For this reason, the efficiency for light utilization of a filter becomes low, as a result the effectiveness of the whole image display device falls, and since the problem that the image shown becomes dark is produced, in order to gather the effectiveness of the whole image display device, it can say that it is more desirable to make small the illuminating angle of the light to a lighting spot.
[0018] Thus, what is necessary is to make a lighting spot as small as possible and just to make small further the illuminating angle of the light to a lighting spot, while it is more small and bright, it is effective to raise the time amount numerical aperture of a space light modulation element in order to realize the good image display device of color reproduction nature, and miniaturizing an emitter and using the smallest possible rotation mold color filter, in order to raise the time amount numerical aperture of a space light modulation element.
[0019]
[Problem(s) to be Solved by the Invention] However, while using miniaturizing an emitter and the smallest possible rotation mold color filter in the case of the method which forms a lighting spot in the combination of the ellipsoid mirror and parabolic mirror which are used conventionally, and a condenser lens, it is difficult to

realize making a lighting spot as small as possible, and making small the illuminating angle of the light to a lighting spot.
[0020] First, if it inquires further, referring to drawing 17 about the illuminating angle of the light to a lighting spot, although the ellipsoid mirror 121 catches the light which an emitter 122 emits and forms the lighting spot 123 near the 2nd focus, for acquiring condensing high effectiveness here, it needs to enlarge the condensing range alpha of an ellipsoid mirror. However, if the condensing range alpha is enlarged, the illuminating angle theta of the illumination light will become large. Moreover, although what is necessary is just to make distance x to the 2nd focus small in order to make a lighting spot small, in connection with making distance x small, the illuminating angle theta of the illumination light will become large. On the other hand, if the condensing range alpha is made small, it will become impossible to obtain required brightness and distance x will be enlarged although it is necessary to make the condensing range alpha small or to enlarge distance x to the 2nd focus in order to make the illuminating angle theta of the illumination light small, magnitude y of a lighting spot will become large.
[0021] Moreover, there is a problem said that the miniaturization of the emitter itself is difficult for the metal halide lamp and high pressure mercury vapor lamp which are used for the emitter of the conventional image display device even if it is going to miniaturize the emitter itself in order to make a lighting spot small if the size of an emitter is examined. Moreover, although it is possible to shorten the electrode spacing which forms arc discharge in the case where the lamp using arc discharge is used in order to make a lighting spot small, a good luminescence property will not be able to be acquired in case of this, and the new problem that the lamp current to which a lamp life becomes extremely short and by which arc discharge is not stabilized becomes large, and a power source is enlarged will arise. The problem that the magnitude of an emitter will furthermore change during a life period according to lighting time amount is also produced. This also produces the problem that an inter-electrode gap will spread soon if in the case of the lamp using arc discharge an electrode is exhausted according to lighting time amount and lighting is repeated, as a result a discharge arc will also become larger and larger soon if lighting is repeated repeatedly, as a result a lighting spot will also become larger and larger.
[0022] Thus, the problem that a lighting spot becomes large gradually as a gap inter-electrode therefore to the life period of a lamp becomes gradually large although it will be decided according to the magnitude of an emitter if the magnitude of the lighting spot formed on a rotation mold color filter has fixed optical system, that is, it becomes gradually large [a discharge arc], that is, it becomes gradually large [an emitter] and lighting is repeated as a result arises.
[0023] Furthermore, when mass-producing a lamp, the problem that it will be comparatively difficult to manage the inter-electrode gap of all lamps with a sufficient precision uniformly, dispersion will arise and make it an inter-electrode gap distance, and the error between products will become large by that of ****** is also produced. That is, it is very complicated to measure above-mentioned dispersion to lamp each, and to set up the time amount numerical aperture of a space light modulation element for every product corresponding to each lamp, and it is difficult. Therefore, this is unreal although it is necessary to decide the time amount numerical aperture of a space light modulation element according to the magnitude of the possible biggest emitter in dispersion.
[0024] In order not to generate the still more nearly unnecessary color mixture between the set life periods of an image display device Although which needs to become large, or it is necessary supposing the greatest magnitude to double it with it being alike in the size of the assumed lighting spot and it needs to define the time amount numerical aperture of a space light modulation element, the lighting spot beforehand produced with the emitter after lamp life progress Thus, since it becomes impossible to also obtain the time amount numerical aperture of an indispensable space light modulation element if the time amount numerical aperture of a space light modulation element is defined when using immediately after starting to use an image display device (i.e., an early lamp) It becomes the image display device which cannot obtain required brightness immediately after the beginning of using, and it is a problem too.
[0025] Then, it is offering the image display device which made it possible to give a color sequential indication with high effectiveness to color purity, and the projection mold image display device using this image display device by succeeding in this invention in view of such a trouble, and making it possible to set up highly the time amount numerical aperture of a space light modulation element regardless of the magnitude and the condition of an emitter, without that purpose enlarging equipment.
[0026]

[Means for Solving the Problem] In order to attain the above-mentioned technical problem, in the image display device of this invention according to claim 1 The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, It is the image display device equipped with the 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element. Said 1st illumination system Said lighting spot which abbreviation's is in the aspect ratio of the viewing area of said space light modulation element by carrying out, and has an aspect ratio is formed. Said 2nd illumination system By synchronizing the red and blue which are formed with said rotation mold color filter, and each green colored light and the display of said space light modulation element It is characterized by considering said lighting spot and said space light modulation element as abbreviation conjugate relation, and carrying out abbreviation coincidence of the direction of a shorter side of said lighting spot, and the circumferencial direction of said rotation mold color filter.
[0027] In the image display device of this invention according to claim 2 The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, The 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element, preparation ************** -- it is -- said 1st illumination system -- an optical integrator component -- having -- abbreviation -- it is characterized by forming said lighting spot which has uniform brightness distribution.
[0028] In the image display device of this invention according to claim 3 The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, It is the image display device equipped with the 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element. Said 1st illumination system While forming the real image of said light source near the exit pupil which forms said lighting spot, it has an aperture diaphragm near said exit pupil, and said 2nd illumination system is characterized by considering said lighting spot and said space light modulation element as abbreviation conjugate relation.
[0029] In the image display device of this invention according to claim 4 In an image display device given in any 1 term of claim 1 thru/or claim 3 said 2nd illumination system The input section convergent lens arranged near [said] the lighting spot, and the output section convergent lens arranged near [said] the space light modulation element, Said input section convergent lens and the center-section convergent lens arranged at the optical path between said output section convergent lenses, A preparation and said input section convergent lens make the light which carries out incidence to said input section convergent lens converge near the opening core of said center-section convergent lens. Said center-section convergent lens forms the real image of the body near the principal plane of said input section convergent lens near the principal plane of said output section convergent lens, and said output section convergent lens is characterized by drawing the light which carries out outgoing radiation from said center-section convergent lens effective in a space light modulation element.
[0030] In the image display device of this invention according to claim 5 In an image display device according to claim 2 said 1st illumination system It has the 1st lens array which comes to arrange two or more 1st lenses in the shape of-dimensional [2], and the 2nd lens array which comes to arrange two or more 2nd lenses in the shape of-dimensional [2]. Said two or more 1st lenses While dividing into two or more partial flux of lights the flux of light which carries out outgoing radiation from said condensing means, said partial flux of light is made to

converge near the opening of said 2nd lens corresponding to said 1st lens. Said two or more 2nd lenses While drawing said two or more partial flux of lights which carry out outgoing radiation from said 1st corresponding lens near the rotation mold color filter, make these superimpose and a lighting spot is formed. Said 1st lens array and said 2nd lens array are characterized by forming said uniform lighting spot of abbreviation brightness as said optical integrator component.
[0031] In the projection mold image display device of this invention according to claim 6 The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, The 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element, It is the projection mold image display device equipped with the projection lens which projects the optical image displayed on said space light modulation element. Said 1st illumination system Said lighting spot which abbreviation's is in the aspect ratio of the viewing area of said space light modulation element by carrying out, and has an aspect ratio is formed. Said 2nd illumination system By synchronizing the red and blue which are formed with said rotation mold color filter, and each green colored light and the display of said space light modulation element It is characterized by considering said lighting spot and said space light modulation element as abbreviation conjugate relation, and carrying out abbreviation coincidence of the direction of a shorter side of said lighting spot, and the circumferencial direction of said rotation mold color filter.
[0032] In the projection mold image display device of this invention according to claim 7 The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, The 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element, the projection mold image display device equipped with the projection lens which projects the optical image displayed on said space light modulation element -- it is -- said 1st illumination system -- an optical integrator component -- having -- abbreviation -- it is characterized by forming said lighting spot which has uniform brightness distribution.
[0033] In the projection mold image display device of this invention according to claim 8 The light source which emits the white light, and a condensing means to collect the synchrotron orbital radiation of said light source, and to form the flux of light of an abbreviation single, The 1st illumination system which forms a rectangular lighting spot using the flux of light formed by said condensing means, The rotation mold color filter which is arranged near [said] the lighting spot and changes said white light to red, blue, and each green colored light one by one, Red, blue, and the space light modulation element used for changing each green color subject-copy image serially, and displaying it, The 2nd illumination system which forms the illumination light which condenses the light which passes said lighting spot and illuminates said space light modulation element, It is the projection mold image display device equipped with the projection lens which projects the optical image displayed on said space light modulation element. Said 1st illumination system While forming the real image of said light source near the exit pupil which forms said lighting spot, it has an aperture diaphragm near said exit pupil, and said 2nd illumination system is characterized by considering said lighting spot and said space light modulation element as abbreviation conjugate relation.
[0034] In the projection mold image display device of this invention according to claim 9 In a projection mold image display device given in any 1 term of claim 6 thru/or claim 8 said 2nd illumination system The input section convergent lens arranged near [said] the lighting spot, and the output section convergent lens arranged near [said] the space light modulation element, Said input section convergent lens and the center-section convergent lens arranged at the optical path between said output section convergent lenses, A preparation and said input section convergent lens make the light which carries out incidence to said input section convergent lens converge near the opening core of said center-section convergent lens. Said center-section convergent lens forms the real image of the body near the principal plane of said input section convergent lens near the principal plane of said output section convergent lens, and said output section

convergent lens is characterized by drawing the light which carries out outgoing radiation from said center-section convergent lens effective in a space light modulation element.
[0035] In the projection mold image display device of this invention according to claim 10 In a projection mold image display device according to claim 7 said 1st illumination system It has the 1st lens array which comes to arrange two or more 1st lenses in the shape of-dimensional [2], and the 2nd lens array which comes to arrange two or more 2nd lenses in the shape of-dimensional [2]. Said two or more 1st lenses While dividing into two or more partial flux of lights the flux of light which carries out outgoing radiation from said condensing means, said partial flux of light is made to converge near the opening of said 2nd lens corresponding to said 1st lens. Said two or more 2nd lenses While drawing said two or more partial flux of lights which carry out outgoing radiation from said 1st corresponding lens near the rotation mold color filter, make these superimpose and a lighting spot is formed. Said 1st lens array and said 2nd lens array are characterized by forming said uniform lighting spot of abbreviation brightness as an optical integrator component.
[0036]
[Embodiment of the Invention] Hereafter, it explains, referring to a drawing about the gestalt of operation of this invention. In addition, the gestalt of operation shown here is an example to the last, and ****** is not limited to the gestalt of this operation, either.
[0037] (Gestalt 1 of operation) It explains first as a gestalt of the 1st operation of the image display device corresponding to claim 1 and claim 4 of this invention, referring to a drawing. Drawing 1 is the outline block diagram of the image display device A concerning the gestalt 1 of this operation. This image display device A is equipped with an emitter 10, a parabolic mirror 11, anamorphic lenses 13 and 14, the attachment lens 15, the rotation mold color filter 16, the relay lens system 21, and the liquid crystal panel 22.
[0038] An emitter 10 is the light source which emits the white light formed with the lamp which is not illustrated here, and a parabolic mirror 11 condenses the white light which an emitter 10 emits, and it forms the flux of light which advances in parallel about in accordance with an optical axis 12.
[0039] Two anamorphic lenses 13 and 14 condense the white light which carries out incidence to these, and form the rectangular lighting spot 17 on the rotation mold color filter 16. Moreover, two anamorphic lenses 13 and 14 have different radius of curvature, and form the lighting spot of the rectangle of a suitable aspect ratio. In addition, the curvature direction of two anamorphic lenses 13 and 14 lies at right angles.
[0040] An attachment lens 15 is used in order to make it the beam of light which carries out incidence to the rotation mold color filter 16 become near in parallel with an optical axis 12. In addition, the 1st illumination system is constituted by these anamorphic lenses 13 and 14 and the attachment lens 15, and the rectangular lighting spot 17 is formed on the rotation mold color filter 16 of this 1st illumination system. About the lighting spot 17, it mentions later.
[0041] As it is the same as that of the rotation mold color filter 106 explained referring to drawing 16 in explanation of a Prior art and is shown in drawing 2 , red transparency mold die clo IKKU filter 29R, transparency mold die clo IKKU filter 29G [green], and blue transparency mold die clo IKKU filter 29B** have fixed the rotation mold color filter 16 to the rotation base material (hub) 28 directly linked with the motor 23. Although what formed die clo IKKU multilayers by vacuum evaporationo or the spatter method of construction on the glass base material of transparence is used for each [these] filters 29R, 29G, and 29B as the Prior art explained too, they are not necessarily limited to the filter manufactured by doing in this way.
[0042] the relay lens system 21 which is the 2nd illumination system -- the input section convergent lens 18, the center-section convergent lens 19, and the output section convergent lens 20 -- since -- it is constituted. The input section convergent lens 18 makes the light which carried out outgoing radiation from the lighting spot 17 on the rotation mold color filter 16 converge, and forms the real image of the exit pupil to the lighting spot 17 on opening of the center-section convergent lens 19. In addition, this exit pupil is specifically located in 13 or about 14 anamorphic lens. The center-section convergent lens 19 forms the real image near the principal plane of the input section convergent lens 18 near the opening of the output section convergent lens 20, and leads the light which carries out outgoing radiation from the input section convergent lens 18, and reaches the center-section convergent lens 19 to the output section convergent lens 20. The output section convergent lens 20 makes light which carries out outgoing radiation from the center-section convergent lens 19 the flux of light which advances to an optical axis 12 at abbreviation parallel, and this flux of light illuminates a liquid crystal panel 22. And the well-known liquid crystal panel which explained the liquid crystal panel 22 by the Prior art is used.
[0043] In the image display device A constituted by these members, it is condensed by the parabolic mirror 11,

and the light which an emitter 10 emits reaches the lighting spot 17 on the rotation mold color filter 16 through anamorphic lenses 13 and 14 and an attachment lens 15, and, finally reaches a liquid crystal panel 22 via the relay lens system 21 which serves as more the input section convergent lens 18, the center-section convergent lens 19, and the output section convergent lens 20. And the relay lens system 21 considers the lighting spot 17 and a liquid crystal panel 22 as abbreviation conjugate relation by synchronizing the red and blue which are formed with the rotation mold color filter 16, and each green colored light and the display of a liquid crystal panel 22. Thus, the great portion of light which an emitter 10 emits illuminates a liquid crystal panel 22 effectively.
[0044] If the relation between the lighting spot 17 and a liquid crystal panel 22 is seen, the lighting spot 17 will be formed on the rotation mold color filter 16 here. Although color filters 29R, 29G, and 29B rotate at a high speed according to each color subject-copy image which a liquid crystal panel 22 displays, it is made to synchronize with a display image and the illumination light of a suitable color is formed, and the liquid crystal panel 22 is illuminated as this illumination light is a **** In the image display device A in the gestalt of this operation, in order to obtain a brighter image (i.e., in order to make the time amount numerical aperture of a liquid crystal panel 22 into the highest possible effectiveness), the following work is carried out.
[0045] since the square pixel is horizontally arranged to 854 pieces and 480 perpendicular directions on the wide screen for digital TV when an image display device A is made to correspond to the wide screen of a digital TV application -- the aspect ratio (ratio of horizontal die length and the vertical die length) of the viewing area of a liquid crystal panel 22 -- 16:9 -- then, it is good. And according to an operation of the relay lens system 21, since the image display device A is considering about the lighting spot 17 and the viewing area of a liquid crystal panel 22 as conjugate relation, it makes the lighting spot 17 the configuration of the viewing area of a liquid crystal panel 22 at the rectangle configuration of 16:9 in all aspect ratios. And with the image display device A, the lighting spot 17 is made into the rectangle configuration which has the aspect ratio of 16:9 by completing appropriately the light which carries out incidence to these lenses using two anamorphic lenses 13 and 14 with which the curvature direction intersects perpendicularly. And as shown in drawing 2 , the rotation mold color filter 16 is arranged so that the rotating circumferencial direction (tangential direction) and the direction of a shorter side (x) of the lighting spot 17 of the rectangle formed may become in the same direction. Since time amount to which a lighting spot is equivalent to the joint of a color filter can be shortened when forming a rectangular lighting spot when forming a circular lighting spot, and making in agreement the direction of a long side and circumferencial direction, if it does in this way, the time amount numerical aperture of a liquid crystal panel 22 is made high. That is, since the shorter side (x) of the rectangular lighting spot 17 can shorten relatively the idle period at the time of the change of the color in short ******** and a display device, it is being able to make high the time amount numerical aperture of a liquid crystal panel 22.
[0046] If a forward diameter of circle is D when the right circle and rectangle which incidentally have the same area are compared, although the die length x of a rectangular shorter side sets the die length of the long side to y and it is expressed with x= (pi/4), (D/y), and D, each of pi/4 and D/y of it being smaller than 1 is obvious.
[0047] Therefore, if it is smaller than a diameter D and the area of a lighting spot is the same, since a lighting spot can shorten time amount which passes the joint of a color filter rather than the case where it considers as a spot with more nearly circular forming a rectangular spot, the die length x of a shorter side can make high the time amount numerical aperture of a liquid crystal panel 22.
[0048] In addition, even if it is cases, such as a display device which has the aspect ratio of 4:3 which is the display size of ordinary Braun-tube TV which is carrying out the case, for example, current circulation, which has the aspect ratio mentioned above and a different aspect ratio, the same operation and effectiveness as **** are acquired. Thus, the image display device A concerning the gestalt of this operation is used as the screen-display equipment which can realize high color purity by making high the time amount numerical aperture of a liquid crystal panel 22.
[0049] (Gestalt 2 of operation) Next, it explains, referring to a drawing as a gestalt of the 2nd operation of the image display device B corresponding to claim 2, claim 4, and claim 5 of this invention. Although drawing 4 is the outline block diagram of an image display device B, it attaches the number same about the same member as the image display device A shown in drawing 1 , and omits about the explanation.
[0050] In this image display device B, although the lighting spot 17 shall have rectangle opening of about 16:9 aspect ratios of the viewing area of a liquid crystal panel 22, and similarity, it is not limited to this. And like the above-mentioned image display device A, even a liquid crystal panel 22 is led by the relay lens system 21, and the flux of light which passes this illuminates the viewing area of a liquid crystal panel 22. And the lighting spot

17 and the liquid crystal panel 22 serve as conjugate relation. In addition, the relation between the liquid crystal panel 22 color-order-degree-displayed and the rotation mold color filter 16 is the same as that of what was explained in the image display device A, and the lighting spot 17 of the rectangle of 16:9 aspect ratio has improved the time amount numerical aperture of a liquid crystal panel 22 by making a shorter side agree with the circumferencial direction which a rotation mold color filter rotates similarly.
[0051] in order [and] to obtain the image which excelled [image display device / B / in the gestalt 2 of this operation] in color purity more brightly -- abbreviation -- the optical integrator component is introduced into the 1st illumination system so that the lighting spot which has uniform brightness distribution can be obtained. Hereafter, an optical integrator component is explained.
[0052] Since there is a property which cut-off wavelength shifts greatly in it when the illuminating angle of exposure light is wide range in the die clo IKKU filter used as a rotation mold color filter 16 of an image display device B and varies in it, if it is going to pass more quantity of lights, color purity will fall, and if it is going to realize high color purity, it will cut to the light of a required wavelength band. What is necessary is just to equalize the illuminating angle of the exposure light to a die clo IKKU filter by introducing an optical integrator component into the 1st illumination system, in order to improve this trouble.
[0053] Then, if the optical integrator (integrator) component which has an integral operation in the part of the 1st illumination system which forms the lighting spot 17 optically is introduced, when the illumination light will result in the lighting spot 17 on the rotation mold color filter 16, the illuminating angle of the illumination light to the rotation mold color filter 16 is equalized, and brightness distribution serves as abbreviation homogeneity. That is, light especially with a big illuminating angle will not arise, but the illuminating angle of the exposure light to a die clo IKKU filter will be equalized.
[0054] Furthermore, by making brightness distribution of the lighting spot 17 into abbreviation homogeneity by introducing an optical integrator component into the 1st illumination system, brightness distribution of the light which illuminates the liquid crystal panel 22 used as this and conjugate relation also serves as abbreviation homogeneity, namely, image display with little brightness unevenness can be realized.
[0055] Although the lens array is used as an optical integrator component and a lens array and the image display device B using this lens array are hereafter explained further with the gestalt 2 of this operation, things other than a lens array may be used as an optical integrator component.
[0056] As shown in drawing 4 , the 1st illumination system in an image display device B is constituted by the 1st lens array 30, the 2nd lens array 32, the convergent lens 34, and the attachment lens 35, and these are arranged to the outgoing beam of a parabolic mirror 11.
[0057] As shown in drawing 5 , the 1st lens array 30 is constituted by arranging the 1st lens 31 which has rectangle opening of 16:9 aspect ratios of the viewing area of a liquid crystal panel 22, and similarity in the shape of-dimensional [2]. The 1st lens 31 is arranged so that the forward circular region which is the circular flux of light cross section (circular [show / the drawing destructive line 36 / and]) which carries out outgoing radiation from a parabolic mirror 11 may be resembled. In addition, limitation is not carried out to the thing illustrating especially the number and the array approach of the 1st lens 31. And as shown in drawing 6 , the 2nd lens array 32 arranges the 2nd lens 33 like the 1st lens 31, and constitutes it.
[0058] Here, actuation of the 1st lens array 30 and the 2nd lens array 32 is explained. The 1st lens array 30 divides the outgoing beam of the parabolic mirror 11 with comparatively large lighting unevenness into two or more partial flux of lights with the 1st lens 31. The number of the partial flux of light divided is equal to the number of the 1st lens 31. The unevenness of these partial flux of light of brightness has decreased.
[0059] The partial flux of light divided with the 1st lens 31 is drawn and converged on opening of the 2nd lens 33 (for example, 2nd lens 33a supports 1st lens 31a.) corresponding to the 1st lens 31, respectively. The 2nd lens 33 considers mutually rectangle opening and the lighting spot 17 of the 1st lens 31 as conjugate relation by giving the suitable scale factor for the partial flux of light which carried out incidence, and irradiating towards the lighting spot 17.
[0060] Thus, it acts as an integrator (integrator) component with optical these 1st lens array 30 and 2nd lens array 32, and the lighting spot 17 of uniform brightness distribution with little unevenness is formed.
[0061] In addition, a convergent lens 34 sends the beam of light on which the flux of light which carries out outgoing radiation was made to superimpose on the lighting spot 17 through an attachment lens 35 from each 2nd lens 33. Moreover, it is made for the beam of light with which an attachment lens 35 results in the lighting spot 17 to become an optical axis 12 and abbreviation parallel.
[0062] Thus, it explains further which makes small the incident angle of the exposure light to the rotation mold

color filter 16 with constituting the 1st illumination system compared with the conventional case, i.e., which is effective?, referring to an example. In addition, in the following explanation, by 2mm, when the lighting spot was formed using the conventional ellipsoid mirror about the light emitted from the side face of the emitter near the cylindrical shape which is 1mm, and when a diameter constitutes the lighting spot 17 using the 1st illumination system in the image display device B concerning the gestalt of this operation, it sticks, and die length compares.
[0063] First, the case where a lighting spot is formed using the conventional ellipsoid mirror is considered.
[0064] the 1st shown in drawing 7 -- focal distance:F1=10mm and 2nd focal distance:F -- when a 2= 100mm ellipsoid mirror is used, the scale factor in the paraxial of the lighting spot formed on the 2nd focus becomes F2/F1=100/10=10 time. Moreover, the magnitude of the diameter direction of an emitter is set to 1mmx10=10mm, and the lighting spot of the shape of circular [which has the diameter of about 10mm / forward] is formed. However, 10mm in this case is the spot size of the standard in paraxial count. And brightness distribution of this lighting spot comes to be shown in drawing 8 . Moreover, the maximum illuminating angle theta in a lighting spot will become about 27.1 degrees, if an ellipsoid mirror condenses in the range of alpha= 135 converging angles.
[0065] Thus, by the conventional method only using an ellipsoid mirror, it turns out that it crossed to the range in which the brightness unevenness on a lighting spot is large, namely, the illuminating angle of light is larger than optical reinforcement has fallen rapidly toward an outside from the core of a lighting spot as shown in drawing 8 , and has spread. This is the same also about the case where a parabolic mirror and a condenser lens are combined.
[0066] Next, the case where the lighting spot 17 is constituted using the 1st illumination system in the image display device B concerning the gestalt 2 of this operation is considered. Since the effective diameter of the flux of light which carries out outgoing radiation will be set to about 97mm from a parabolic mirror 11 if it condenses in the range of alpha= 135 converging angles using the focal distance:F=10mm parabolic mirror 11 as shown in drawing 9 opening of the 1st lens 31 of each -- horizontal: -- the 1st lens 31 is arranged and the 1st lens array 30 can be constituted so that it may be inscribed in 15.2mm, vertical:8.55mm, then the flux of light (broken line 36 shown in drawing 5) with a diameter of 97mm which carries out outgoing radiation from a parabolic mirror 11.
[0067] Next, if the rectangle area size of 16:9 aspect ratios which has the same area as a right circle with a diameter of 10mm which is the lighting spot obtained by the conventional method is calculated, since the magnitude will be set to horizontal:11.82mm and vertical:6.65mm, the 2nd lens 33 makes the real image of the 1st lens 31 one about 0.78 times (= 11.82/15.2) the scale factor of this, and should just form it on a lighting spot. Therefore, as shown in drawing 9 , distance between the principal planes of the synthetic lens which sets a principal plane, and the 2nd lens array and convergent lens of the 1st lens array, and becomes can be set to X2=154mm, and the distance of a lighting spot can be acquired for the scale factor of X1=120mm, then almost a request from the principal plane of a synthetic lens. And the maximum illuminating angle theta to about 97mm, then a lighting spot is theta=tan about the effective diameter of the 2nd lens array. - It becomes 1(48.5/120) = 22 degrees. Moreover, the brightness distribution in the lighting spot in this case is as being shown in drawing 10 .
[0068] Therefore, if the case where the conventional case and the gestalt 2 of this operation which were mentioned above are started is compared, at the lighting spot which the magnitude (die length) of the lighting spot to the circumferencial direction of a rotation mold color filter consists of in the conventional ellipsoid mirror to being set to 6.65mm in the case of an image display device B, it is set to 10mm and it turns out that the direction of an image display device B can shorten a time amount numerical aperture. Moreover, since there is little light which the direction in the case of starting the gestalt of this operation reaches in addition to a required predetermined field about the direction of a shorter side of a rectangular lighting spot so that clearly if drawing 8 is compared with drawing 10 , color mixture can be prevented more. Furthermore, to the maximum illuminating angle of the light which reaches a lighting spot being 22 degrees in the case of an image display device B, in the conventional configuration, it becomes 27.1 degrees, and it turns out that things can do smaller the maximum illuminating angle of the light which reaches a lighting spot in an image display device B.
[0069] However, in order [which was shown in the above-mentioned example] to prevent color mixture and to make the maximum illuminating angle small, the spacing of the 1st lens array and the 2nd lens array must be [like] appropriate [like]. That is, if distance X2 is large, it is obvious that X1 becomes large and the illuminating angle to a lighting spot becomes small. That is, in a suitable combination of X1 and X2, the 22

above-mentioned maximum illuminating angles are acquired.
[0070] By the way, although [all the magnitude of the 2nd lens which constitutes the 2nd lens array shown in drawing 6] it is the same therefore, since the real image of an illuminant cannot be covered completely, optical loss will be produced. Then, the 2nd lens array shown in drawing 6 is considering as a different configuration, and the lens array which decreases optical loss more is explained hereafter, referring to a drawing.
[0071] If distance X2 in the image display device B shown in drawing 9 is lengthened, the real image of the emitter formed on the 2nd lens will become large, and optical loss will be produced about the light formed by protruding opening of the 2nd lens. Moreover, although the real image of the emitter on the 2nd lens will become small and optical loss will be reduced if distance X2 is shortened, the opening area restricted since each of each partial flux of light passed discretely small in opening of the whole 2nd lens array consequently when the real image of an emitter was too small to opening of the 2nd lens cannot be used effectively.
[0072] The size of the real image formed on the 2nd lens here is examined referring to drawing 9 . The size of the emitter which appears from 10mm and this direction about the top-most-vertices A section of the parabolic mirror which is ****** as for the distance which expects an emitter is set to 1mm. And since the include angle which expects an emitter turns into tan-1(0.1) =5.7 degree, if the light (Ls) which passes a lens (it is 2nd lens 33w, for example if it is drawing 6 .) near on a shaft has the numerical aperture equivalent to this include angle, it can use light most efficiently. And the size of the real image in distance X2 (= 154mm) is set to about 15mm. Moreover, if the B section which is the part which corresponds to alpha= 90 degrees about the light of the condensing direction of alpha= 90 degrees is examined, the die length of the emitter which appears from 20mm and this direction as for the distance of an emitter expected from this part will be set to 2mm. And the size of the real image in the 2nd lens (if it is drawing 6 , it is 2nd lens 33k.) which exists near this path (Lt) is set to about 15mm.
[0073] However, if it goes to the periphery of a parabolic mirror exceeding the B section, the include angle which expects an emitter will decrease steeply. For example, if the C section which is a part applicable to alpha = about 135 degrees is examined, the die length of the emitter which appears from 45mm and this direction as for the distance of an emitter expected from this part will be set to 2mm. And the include angle which expects an emitter will become small even at about 1.4 degrees. And although it can use light most efficiently if the lens (it is 2nd lens 33b, for example if it is drawing 6 .) near the path of this light (Lu) has the numerical aperture equivalent to this include angle In the 2nd lens array which the size of the real image in this part was not set to about 4mm, and was shown in drawing 6 , since the numerical aperture of all the 2nd lens is the same, it cannot be said that light is not necessarily used efficiently.
[0074] Then, what is necessary is just to consider as the lens array which has two or more 2nd lenses which have opening of a different configuration, as shown in drawing 11 in order to gather effectiveness further. Here, a-w shown in drawing 11 shows correspondence relation with each lens of the 1st lens array 30 shown in drawing 5 .
[0075] the 2nd lens array 37 -- the distance from an optical axis -- responding -- every -- opening and magnitude of the 2nd lens 38 were combined the optimal, the lens separated and located from an optical axis in big opening which set the lens located near the optical axis by the big real image has given small opening according to the small real image, and opening of the 2nd lens array 37 whole can be made small, without enlarging optical loss, combining these the optimal. Thus, when combining with the 1st lens array which showed the constituted 2nd lens array to drawing 5 , each of the 1st lens 31 which constitutes the 1st lens array 30 is good to constitute so that the light which carries out [****] a lens optical axis (eccentricity), was made to carry out it to the opening suitably, and carried out outgoing radiation of the 1st lens may reach on opening of the 2nd corresponding lens 38. And if it does in this way, there is an advantage which can make smaller the illuminating angle of the light to a lighting spot.
[0076] As explained above, in the image display device B shown in drawing 4 , it is also possible as an opening configuration of the 2nd lens array as permitted some optical losses, similarly arranged the opening configurations of the 1st lens array and the 2nd lens array according to efficiency for light utilization to realize and shown in drawing 11 to optimize the effectiveness and opening size of the 2nd lens array.
[0077] In addition, in the above-mentioned image display device B, considering as the configuration not using a convergent lens 34 is also considered. What is necessary is to carry out eccentricity of the 2nd lens suitably, to deflect suitably the partial flux of light which passes these, and just to superimpose each partial flux of light on a lighting spot, when not using a convergent lens.
[0078] As mentioned above, although the case where a lens array was used as an optical integrator component

was explained, using a glass rod as an optical integrator component in addition to this is also considered. Hereafter, the case where a glass rod is used is explained briefly, referring to a drawing.
[0079] Drawing 12 is the schematic diagram having shown the configuration of a part of image-display-device B' considered as the configuration which used the glass rod instead of the lens array in the image display device B shown in drawing 4 . It is omitting about the same component as an image display device B here. In this image-display-device B', the light which an emitter 10 emits is condensed in the ellipse mirror 41, and incidence of this is carried out to the rectangular glass rod 42. By repeating total reflection on the side face, the light which carried out incidence to the glass rod 42 can acquire the same operation and effectiveness as the optical integrator component which was mentioned above and which combined the two lens array. In this case, the outgoing radiation end face 43 of a glass rod 42 should just make the configuration of an outgoing radiation end face the rectangle configuration of the same aspect ratio as the viewing area of a liquid crystal panel 22 from determining the configuration of the lighting spot 17. What is necessary is just to constitute an attachment lens 44 so that the glass rod itself may lead when it does not have this although the lighting spot of the glass-rod outgoing radiation edge which equalizes the flux of light and is illuminated is drawn on the rotation mold color filter 16.
[0080] Thus, it is using the 1st lens array 30 which is an optical integrator component, and the 2nd lens array 32, or by using a glass rod 42, color purity can be made high and light of a required wavelength band is not cut. Furthermore, since the brightness homogeneity of the lighting spot 17 becomes high, the homogeneity of the brightness of the light which illuminates the liquid crystal panel 22 used as this and conjugate relation is improved, namely, the illuminating angle of the light in each field angle point is equalized. Therefore, since the maximum illuminating angle of the light which carries out incidence to a rotation mold color filter can be made small, a more desirable image display device is realizable.
[0081] (Gestalt 3 of operation) Next, the image display device C corresponding to claim 5 is explained as a gestalt of the 3rd operation from claim 3 of this invention. In this image display device C, the optical path from a parabolic mirror to a lighting spot is equipped with three lens groups. That is, the flux of light is made to converge by the 1st lens group, and the real image of an emitter is formed. Next, a lighting spot is formed for the 2nd lens group [near the formed real image]. In this case, the principal plane of the 2nd lens group is equivalent to an exit pupil. And the 3rd lens group is arranged near the lighting spot, and it is considering as telecentric lighting.
[0082] And the configuration mentioned above will become the image display device of a configuration of having been shown in drawing 4 itself, if it considers that the 1st lens group is the 1st lens 31 of the 1st lens array 30 and it considers that the 2nd lens 33 of the 2nd lens array 32, a convergent lens 34, and the 3rd lens group are attachment lenses 35 for the 2nd lens group. In this case, if the 2nd lens group is constituted from an anamorphic lens, the lighting spot of the rectangle of a suitable aspect ratio can be constituted. And if the direction of a shorter side of a rectangle lighting spot and orientation of a rotation mold color filter are made suitable, an operation and effectiveness same with having explained in the gestalt of the 1st operation will be acquired.
[0083] Then, it explains further, referring to drawing 4 about an image display device C below. It consists of this image display device C so that the real image of an emitter 10 may be formed on the exit pupil to the lighting spot 17 in the 1st illumination system which forms the lighting spot 17 and the lighting spot 17 may be formed with the so-called Koehler illumination.
[0084] If it explains still more concretely, the 1st lens array 30 will form the real image of two or more emitters 10 near the opening of the 2nd lens array 32, and will serve as an exit pupil of the 1st illumination system in which the forward circular region which approximates the real image of these emitters 10 forms the lighting spot 17. Therefore, the emitter 10 and the lighting spot 17 which are constituted in this way serve as the so-called image and the relation of a pupil, and, for the reason, there is least conjugation relation of each other. In addition, each of the 2nd lens 33 which constitutes the 2nd lens array 32 has opening of finite, and these openings are acting as an aperture diaphragm about corresponding each of two or more partial flux of lights. In addition, since it does not arrive at the field of the lighting spot 17, the light which protruded opening of the 2nd corresponding lens and carried out incidence to the next lens is not used effectively.
[0085] Thus, since the real image of an emitter 10 was formed on the exit pupil to the lighting spot 17 in the image display device C and the still more suitable aperture diaphragm for an exit pupil is prepared, even if the magnitude of an emitter 10 changes, the magnitude of the lighting spot 17 does not change. Therefore, even if it is the case where the magnitude of an emitter 10 therefore changes to dispersion and lamp aging of the lamp at

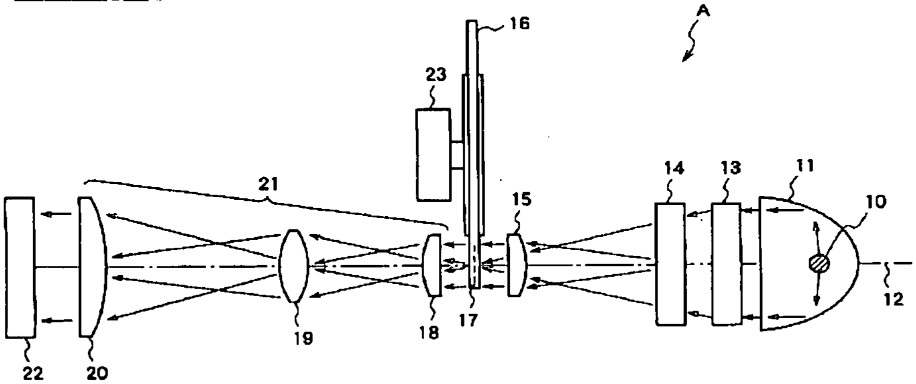
the time of mass production, the lighting spot 17 of the always same magnitude can be obtained. Moreover, since it has a suitable aperture diaphragm for an exit pupil, even if the magnitude of the emitter itself therefore changes to dispersion and the life factor of magnitude of a lamp at the time of manufacture, size of a lighting spot is fixed and generating of the unnecessary stray light can be controlled. Therefore, an image display device can be constituted using the time amount numerical aperture optimized beforehand.
[0086] further -- the size of the lighting spot 17 -- always -- the need -- since it is made to regularity upwards as sufficient magnitude, a rectangular lighting spot is formed and this direction of a shorter side and the rotation circumferencial direction of a rotation mold color filter are made in agreement, the time amount numerical aperture of an image display device C can always be fixed in a high value. Moreover, since a lighting spot is formed using the optical integrator component which consists of a two lens array, the illuminating angle of the illumination light in each field angle is equalized, as fixed, it is bright and the display of color sequential means of displaying with high color purity can be realized that the maximum incident angle to a color filter can be made small, consequently it is easy to be color separation effectiveness. In addition, this two lens array is good, if it considers as the combination of the 1st lens array which has the configuration shown in drawing 5 , and the 2nd lens array which has the configuration shown in drawing 11 . If the 2nd lens array shown in this drawing 11 is used, since total of that opening can be made small, without making optical loss increase according to the magnitude of the real image of two or more emitters formed on the 2nd lens array as explained in the gestalt of the 2nd operation, a lighting spot can be formed with light with a more small illuminating angle.
[0087] Although the image display devices A, B, and C described above showed the case where the transparency mold liquid crystal panel of color sequential means of displaying was used as a space light modulation element, they may not necessarily be limited to this, for example, may be the configurations using the liquid crystal panel of a reflective mold, and the digital micro mirror component (DMD) of a reflective mold.
[0088] (Gestalt 4 of operation) Next, the projection mold image display device corresponding to claim 6 and claim 9 of this invention which come to use the image display device A explained in the gestalt of the 1st operation is explained as a gestalt of the 4th operation.
[0089] Drawing 13 is outline structural drawing of the projection mold image display device D by the gestalt 4 of operation of this invention using the image display measure A explained with the gestalt of the 1st operation. In this projection mold image display device D, the sign same about the same part as an image display device A, i.e., the same part as drawing 1 , is attached, and that explanation is omitted.
[0090] The projection mold image display device D adds the projection lens 48 to an image display device A. In the projection mold image display device D, incidence of the light modulated with the transparency mold liquid crystal panel 22 is carried out to the entrance pupil 49 of the projection lens 48, and expansion projection of the image displayed by color sequential means of displaying is carried out on a screen (here, not shown). Therefore, since a time amount numerical aperture is highly improvable similarly in the image display device A of the gestalt of the 1st operation, a bright projection mold image display device can be obtained.
[0091] (Gestalt 5 of operation) Next, it explains, referring to drawing 14 as a gestalt of the 5th operation of the projection mold image display device E corresponding to claim 7, claim 9, and claim 10 of this invention which comes to use the image display device B explained with the gestalt of the 2nd operation.
[0092] Drawing 14 is outline structural drawing of the projection mold image display device E by the gestalt 5 of operation of this invention using the image display measure B explained with the gestalt of the 2nd operation. In this projection mold image display device E, the sign same about the same part as an image display device B, i.e., the same part as drawing 4 , is attached, and that explanation is omitted.
[0093] The projection mold image display device E adds the projection lens 45 and the space light modulation element 47 of a reflective mold to an image display device B. In the projection mold image display device E, the light modulated with the transparency mold liquid crystal panel 22 illuminates the space light modulation element 47 of a reflective mold, and expansion projection of the modulation image is carried out on a screen (not shown) with the projection lens 45. It is good to use the digital micro mirror component (DMD component) which considered as the space light modulation element of a reflective mold, for example, arranged the minute mirror in the shape of-dimensional [2] here. Since polarization is not used while a DMD component controls the tilt angle of a minute mirror, and the travelling direction of light and a high-speed response is possible for it, as already stated, high efficiency for light utilization is realizable.
[0094] Moreover, by forming the rectangular lighting spot 17 and forming the uniform lighting spot of brightness using the optical integrator component which consists of two lens arrays 30 and 32, since an illuminating angle can be equalized, namely, the maximum incident angle to a color filter can be made small, that it is easy to be a

color separation property, it is bright and the high color sequential display of color purity can be obtained. And since the viewing area and the lighting spot 17 of the space light modulation element 47 are considered as conjugate relation and the homogeneous high lighting spot 17 of brightness is formed, homogeneity of brightness can be made high about the light which illuminates the space light modulation element 47. Consequently, the brightness unevenness of the image projected on a screen is lessened, and the projection mold image display device which can offer the homogeneous outstanding projection image can be obtained.
[0095] (Gestalt 6 of operation) Next, the projection mold image display device F corresponding to claim 8, claim 9, and claim 10 of this invention which comes to use the image display device C explained with the gestalt of the 3rd operation is explained as a gestalt of the 6th operation. The outline structure of this projection mold image display device F is the same as that of what was shown in drawing 14.
[0096] In this projection mold image display device F, since the real image of an emitter is formed on the exit pupil which forms a lighting spot as the image display device C was explained, even if the magnitude of an emitter changes, the magnitude of a lighting spot does not change. Since a fixed and always high time amount numerical aperture is realizable, it is bright and the projection mold image display device F which color mixture does not generate can be realized.
[0097]
[Effect of the Invention] With the image display device according to claim 1 and the projection mold image display device according to claim 6 of this invention, as stated above, since a rectangular lighting spot is formed, the quiescent time of the space light modulation element in the transition period of a color is shortened, and a time amount numerical aperture can be improved highly. Moreover, since the direction of a shorter side of a rectangular lighting spot and the circumferencial direction of a rotation mold color filter are made in agreement, the equipment with more high effectiveness which makes bright image display possible is realized.
[0098] In the image display device according to claim 2 and the projection mold image display device according to claim 7 of this invention, since a lighting spot is formed using an optical integrator component, the homogeneous high lighting spot of brightness can be formed and an illuminating angle can be equalized. Therefore, the maximum illuminating angle can be controlled and color sequential lighting with high color purity and effectiveness can be realized. Moreover, since the direction of a shorter side of a rectangular lighting spot and the circumferencial direction of a rotation mold color filter are made in agreement, the equipment with more high effectiveness which makes bright image display possible is realized.
[0099] In the image display device according to claim 3 and the projection mold image display device according to claim 8 of this invention, since the real image of an emitter was formed on the exit pupil which forms a lighting spot, it does not depend on the magnitude of the real image of an emitter, but since magnitude of a lighting spot is made to regularity, while realizing an always high time amount numerical aperture, generating of color mixture can be prevented. Moreover, since the direction of a shorter side of a rectangular lighting spot and the circumferencial direction of a rotation mold color filter are made in agreement, the equipment with more high effectiveness which makes bright image display possible is realized.
[0100] since it came out with the input section convergent lens, the output section convergent lens, and the center-section convergent lens and the 2nd illumination system was constituted from the image display device according to claim 4 and the projection mold image display device according to claim 9 of this invention, a lighting spot and the viewing area of a space light modulation element can be considered as conjugate relation.
[0101] since it came out with the 1st lens array and the 2nd lens array and the 1st illumination system was constituted from the image display device according to claim 5 and the projection mold image display device according to claim 10 of this invention, it not only makes magnitude of a lighting spot regularity, but it can consider as what also has the very high homogeneity of brightness.

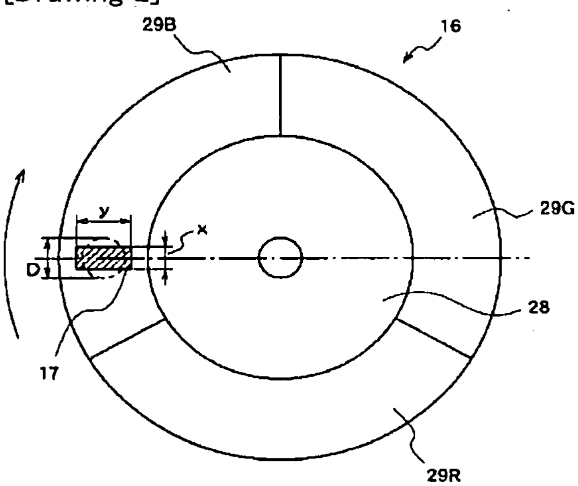
[Translation done.]

DRAWINGS

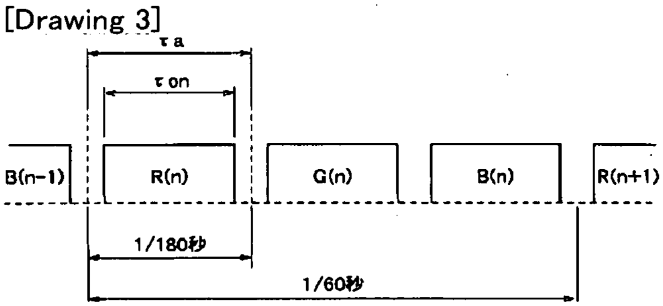
[Drawing 1]



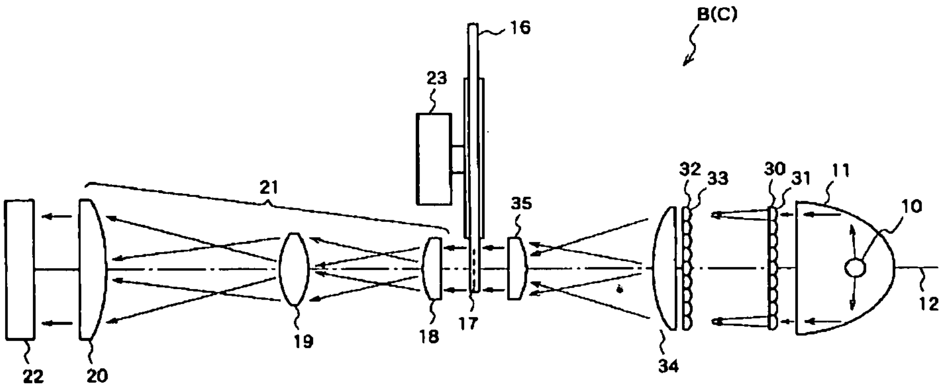
[Drawing 2]



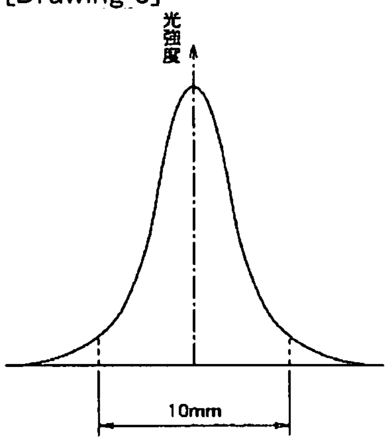
[Drawing 3]



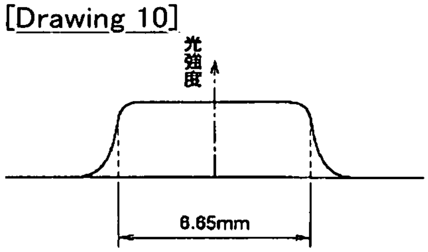
[Drawing 4]



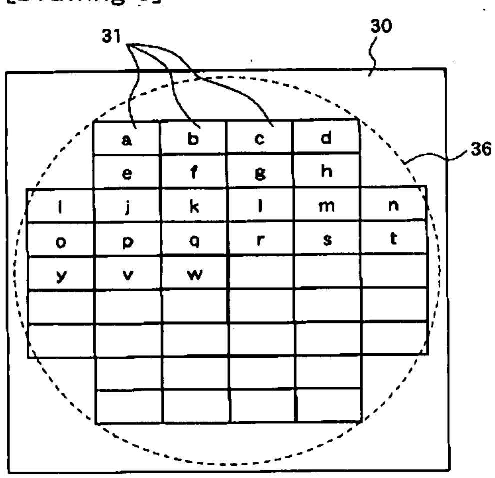
[Drawing 8]



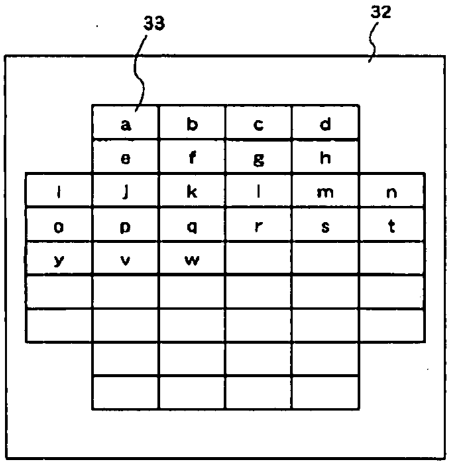
[Drawing 10]



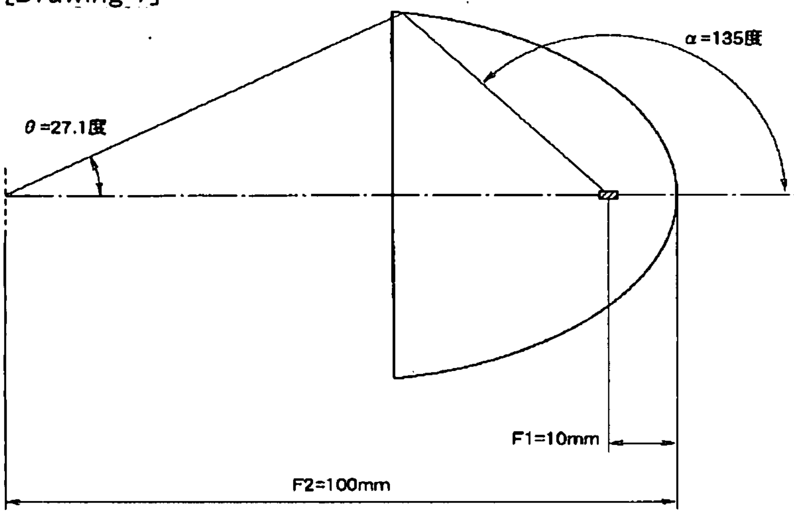
[Drawing 5]



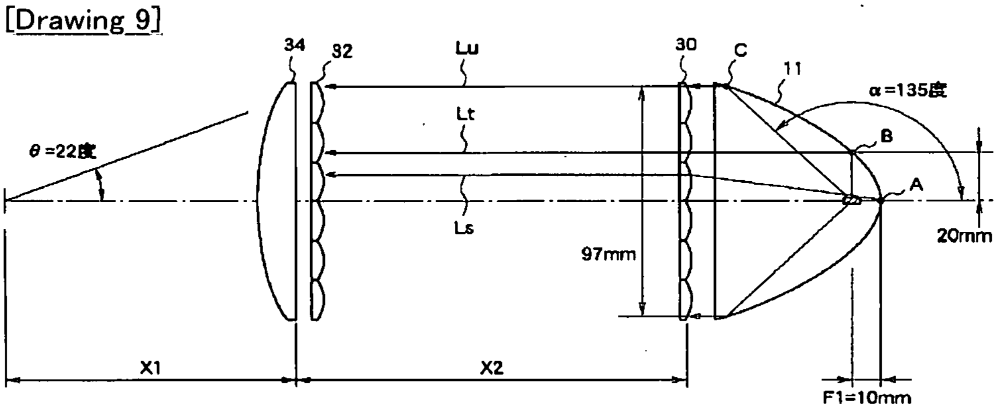
[Drawing 6]



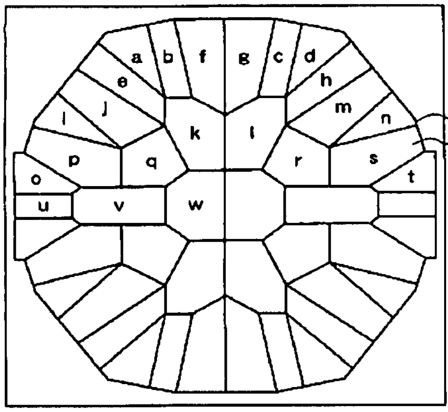
[Drawing 7]



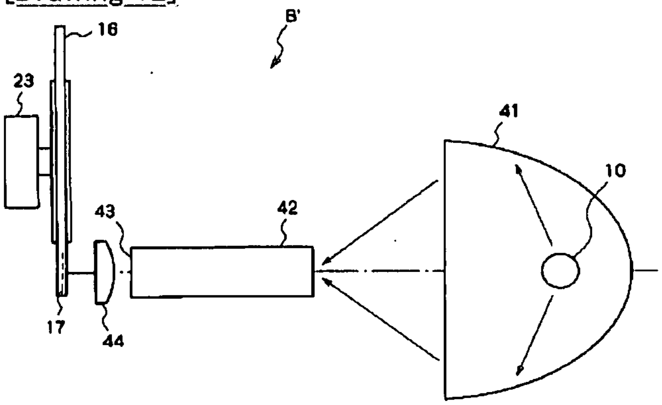
[Drawing 9]



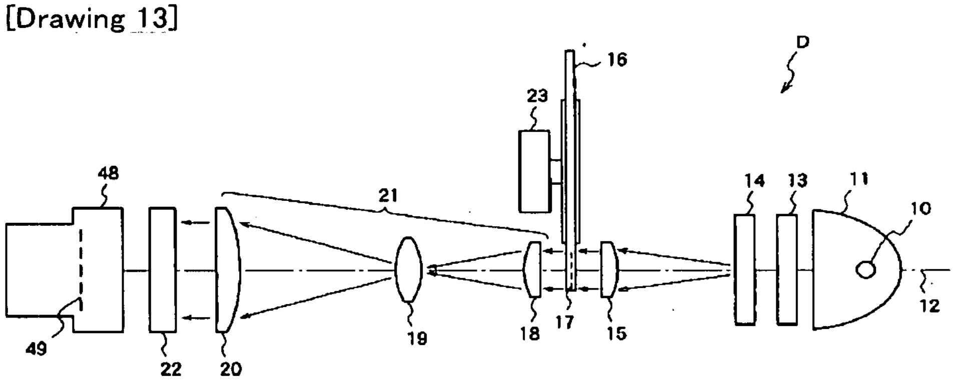
[Drawing 11]



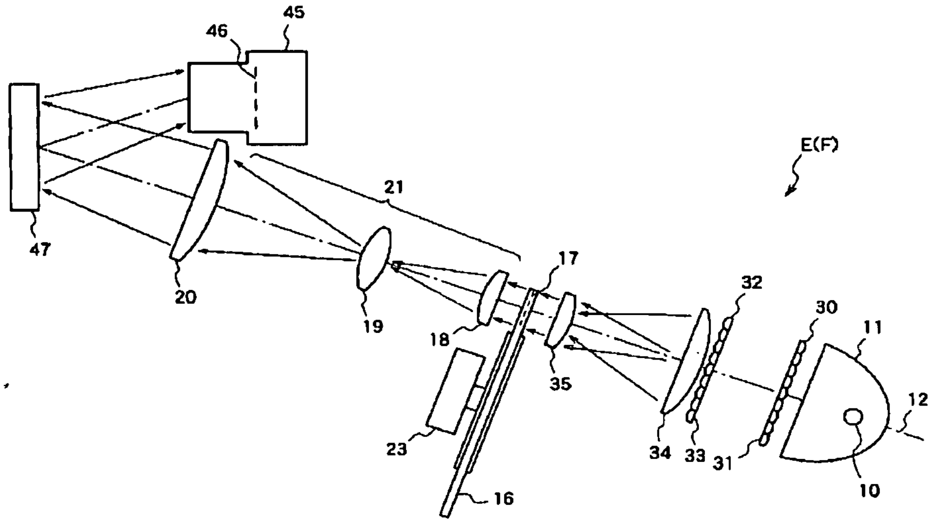
[Drawing 12]



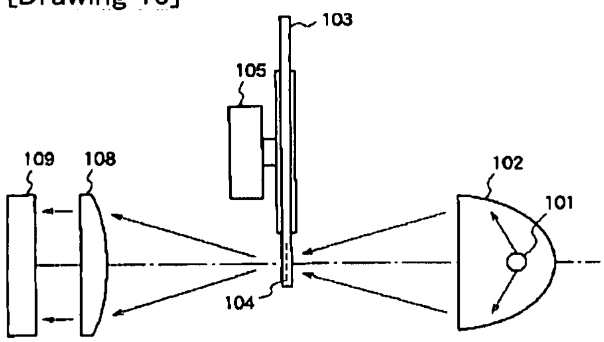
[Drawing 13]



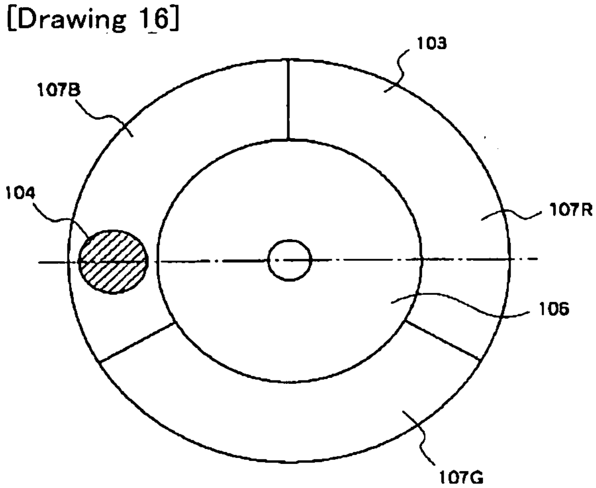
[Drawing 14]



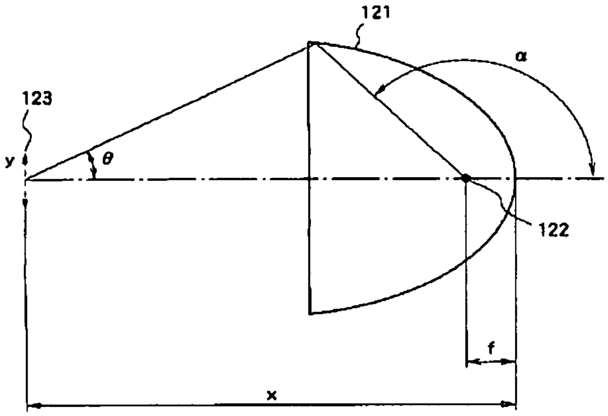
[Drawing 15]



[Drawing 16]



[Drawing 17]



[Translation done.]